REMARKS

This application was originally filed on 20 December 2001 with thirty claims, three of which were written in independent form. Claims 27-30 have been allowed. Claims 1 and 17 have been amended.

The drawings were objected to as failing to comply with 37 C.F.R. 1.84(p)(5). The drawings and the specification have been amended to overcome this objection. Should the proposed changes to the drawings be acceptable, formal drawings incorporating these changes will be submitted upon allowance of the claims of this application.

The specification was objected to for various informalities. The specification has been amended to overcome this objection. A substitute specification is submitted herewith incorporating these changes.

Claims1-26 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,295,154 to Laor et al. ("Laor") in view of U.S. Patent Publication No. 2001/0022682 to McClelland et al. ("McClelland"). Claims 1 and 17 have been amended to overcome this rejection. Specifically, Claim 1 now recites, "said mirror portion and said truss members are formed from a first layer and a second layer, with a thin oxide layer disposed between said first and second layers, portions of said second layer removed to form said truss members and portions of said first layer forming said mirror portion" while Claim 17 now recites, "said single piece of material has a first layer and a second layer, with a thin oxide layer disposed between said first and second layers, portions of said second layer removed to form said truss members and portions of said first layer forming said mirror portion." Laor in view of McClelland does not show, teach, or suggest this limitation.

Claims 2-16 and 18-26 depend from Claims 1 and 17 and should be deemed allowable for that reason and on their own merits. For the reasons argued above with respect to the base claims, Laor in view of McClelland does not show, teach, or suggest the recited elements of the base claim, much less the recited elements of the base claim in combination with the additional elements of the dependent claims.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "Version With Markings To

Show Changes Made."

In view of the amendments and the remarks presented herewith, it is believed that the claims currently in the application accord with the requirements of 35 U.S.C. § 112 and are allowable over the prior art of record. Therefore, it is urged that the pending claims are in condition for allowance. Reconsideration of the present application is respectfully requested.

Respectfully submitted,

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Version With Markings To Show Changes Made

In the specification:

The paragraph beginning on line 1 of page 5 has been rewritten as follows:

Figure 1a is a cross sectional view taken on line 1a--1a of Figure 1;

The paragraph beginning on line 4 of page 5 has been rewritten as follows:

Figure 1c is a cross sectional view taken on line 1c~~b~~—1c~~b~~ of Figure 1;

The paragraph beginning on line 21 of page 7 has been rewritten as follows:

The middle or neutral position of the mirror assembly 10 is shown in Figure 1a, which is a section taken through the assembly along line 1a--1a of Figure 1. The rotation of the mirror portion 16 about the second axis 24 independent of the gimbals portion 14 and/or the frame portion 12 is shown in Figure 1b as indicated by the arrow. Figure 1c shows the middle position of the mirror assembly 10, similar to that shown in Figure 1a, but taken along line 1c~~b~~--1c~~b~~ of Figure 1. The rotation of the gimbals portion 14 and mirror portion 16 about the first axis 20 independent of frame portion 12 is shown in Figure 1d as indicated by the arrow. The above independent rotation of the mirror 22 of mirror portion 16 about the two axes 20/24 allows direction of an optical beam, as needed by optical switch units.

The paragraph beginning on line 6 of page 13 has been rewritten as follows:

After the mirror is fabricated, an optional reflective layer 161 comprising gold or aluminum, as examples, may be deposited over at least the mirror portion 116, as shown in Figure 8. Alternatively, the reflective layer 161 ~~160~~ may be deposited prior to patterning the SOI thin layer 154 to form the frame portion, gimbal portion and mirror portion 112/114/116, not shown.

The paragraph beginning on line 15 of page 14 has been rewritten as follows:

Figure 11 illustrates an embodiment of the micromirror device 110 implemented in an

optical switching station 190. The micromirror device 110 is disposed within an array 198 of a plurality of micromirrors 110. The layout of a matrix optical switch station 190 comprises a plurality of parallelly-extending optical switch units 193 and 194. While two optical switch units 193/194 are shown for the purposes of illustration, alternatively, any number of optical switch units 193/194 may be provided, as desired. Optical switch units 193/194 are mounted in a frame 192 such that they are aligned with an optical switch micromirror device 110 in accordance with embodiments of the invention, the micromirror device 110 being fixedly mounted in housing 191. An end portion of fiber optics cable 196 is mounted in a selected fixed position within housing 191 to optical switch 194 ~~193~~. Similarly, fiber optics cable 195 is affixed within the housing 191 to optical switch 193 ~~194~~. An optical signal 197 is transmitted in cable 196 and is directed by optical switch unit 194, by reflecting optical signal 197 from optical switch mirror 110 to another selected optical switch unit, such as optical switch 193, which directs optical signal 197 into cable 195. Because the micromirror device 110 has a high resonant frequency, switching may be faster than when using prior art micromirror devices.

The paragraph beginning on line 1 of page 16 has been rewritten as follows:

Because the mirror portion 116 and gimbal portion 114 have a reduced thickness, e.g., one-tenth the thickness of prior art micromirror devices, the micromirror device 110 has lower mass moment of inertia and a higher resonant frequency, e.g. in the order of thousands of Hertz. This micromirror 110 with a truss support structure will allow very large area mirrors to be fabricated with the highest possible resonant ~~resoanant~~ frequencies, e.g. up to 5 mm width per side. The resonant frequency of the micromirror 110 is increased by reducing the mass moment of interia of the mirror and gimbal portions 116/114. This is especially important for large silicon mirrors (diameters >2 mm) for which the resonant frequency is on the order of normal building and shipping vibrations.

The paragraph beginning on line 11 of page 16 has been rewritten as follows:

When the mirror portion comprises a mirror having a width of at least 2 mm on at least one side, embodiments of the present micromirror 110 having a plurality of truss membranes 140/142 disposed beneath the mirror and gimbal portions 116/114 are particularly advantageous in fiber optic switches, fiber optic networks, optical wireless communications, scanners, and/or other micromirror applications. In particular, in scanner applications, getting the resonant frequency up into the kiloHertz range is important which is achievable with embodiments of the present invention. Furthermore, for optical wireless, micromirrors 110 having relatively large mirrors 116 ~~122~~, e.g., (diameters >2 mm) are important.

In the claims:

Claims 1 and 17 have been amended as follows:

1. (amended) A micromirror device, comprising:

an outer frame portion;

a rotational gimbal portion hinged to the frame portion and moveable relative to the frame portion about a first axis;

an inner rotational mirror portion having a reflective upper face surface hinged to the gimbal portion for movement of the mirror portion relative to the gimbal portion about a second axis; and

a plurality of truss members disposed beneath at least the inner rotational mirror portion, said mirror portion and said truss members are formed from a first layer and a second layer, with a thin oxide layer disposed between said first and second layers, portions of said second layer removed to form said truss members and portions of said first layer forming said mirror portion.

17. (amended) A micromirror device, comprising:

an outer frame portion;

a rotational gimbal portion hinged to the frame portion and moveable relative to the frame portion about a first axis;

an inner rotational mirror portion having a reflective upper face surface hinged

to the gimbal portion for movement of the mirror portion relative to the gimbal portion about a second axis; and

a plurality of truss members disposed beneath the inner rotational mirror portion and the gimbal portion, wherein at least the gimbal portion and mirror portion are formed from a single piece of material, said single piece of material has a first layer and a second layer, with a thin oxide layer disposed between said first and second layers, portions of said second layer removed to form said truss members and portions of said first layer forming said mirror portion.

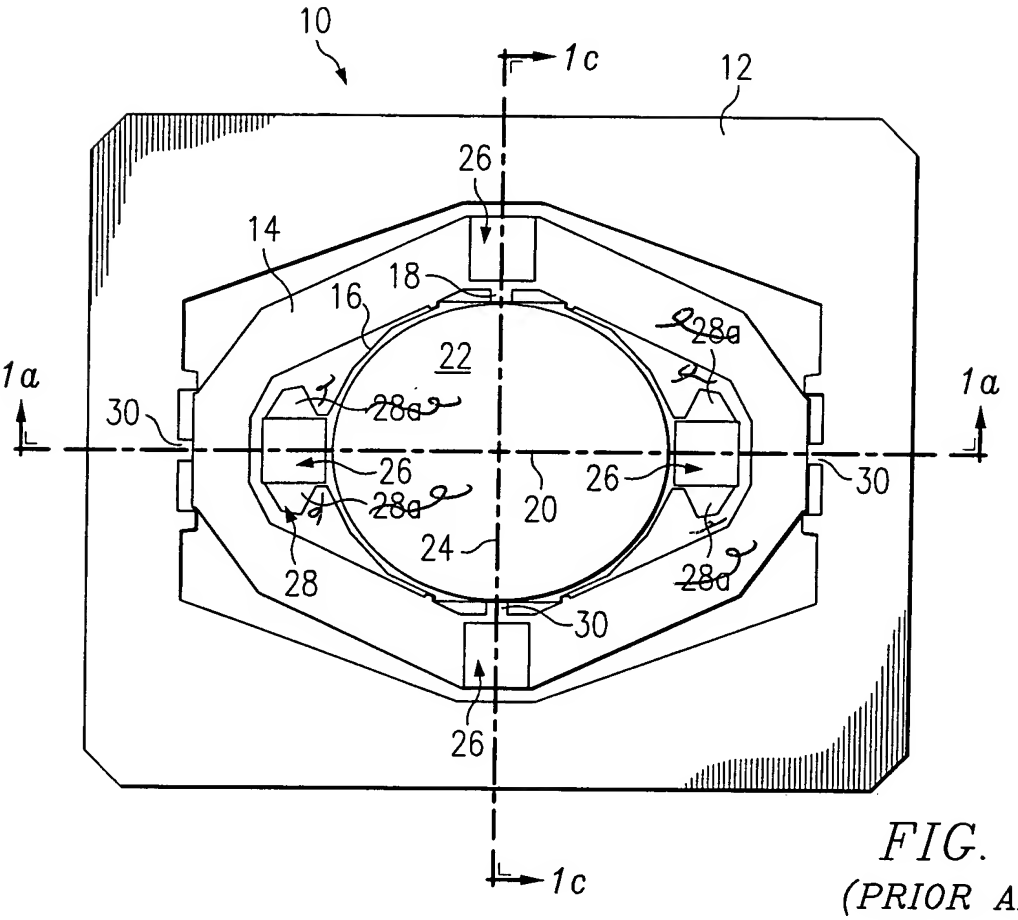

FIG. 1
(PRIOR ART)

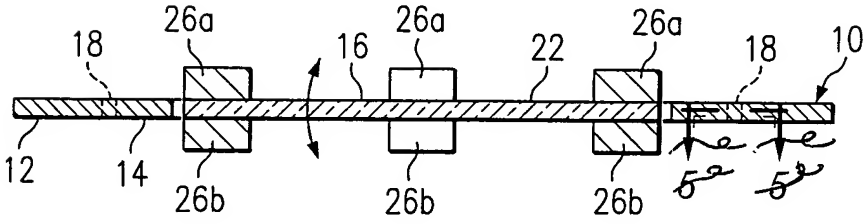

FIG. 1a
(PRIOR ART)

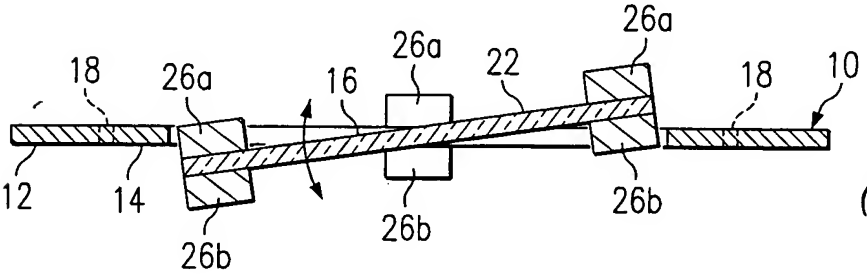

FIG. 1b
(PRIOR ART)

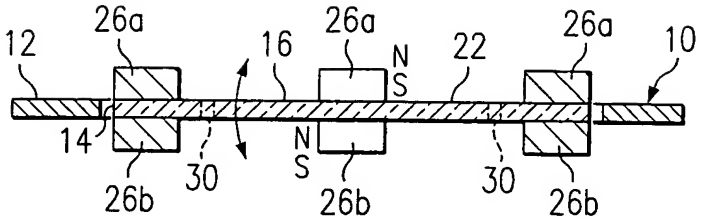

FIG. 1c
(PRIOR ART)

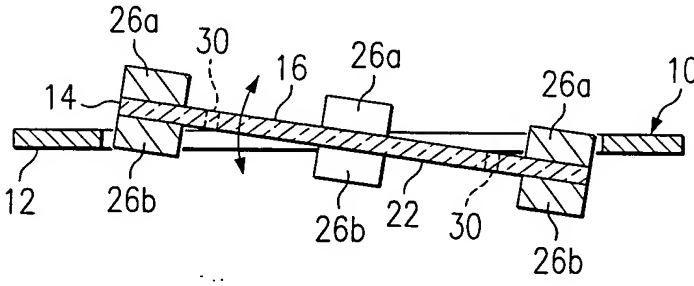

FIG. 1d
(PRIOR ART)

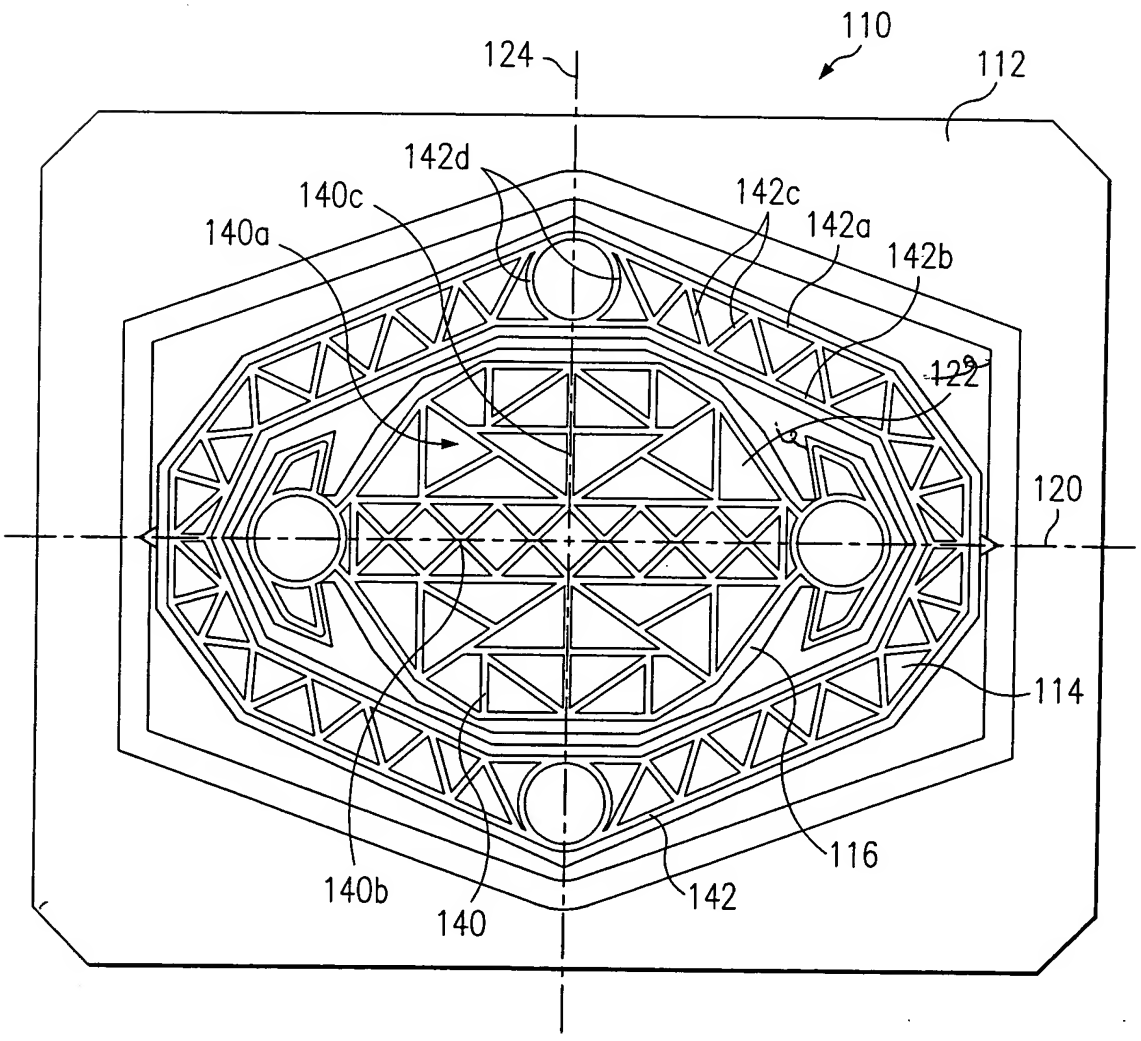

FIG. 2

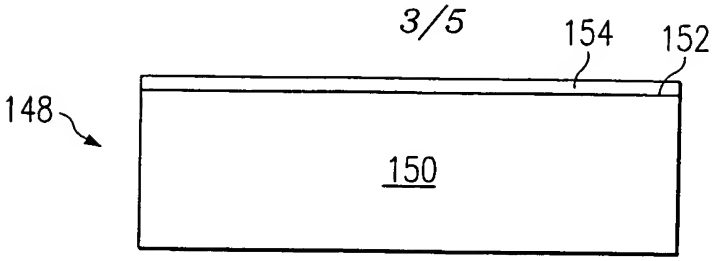

FIG. 3

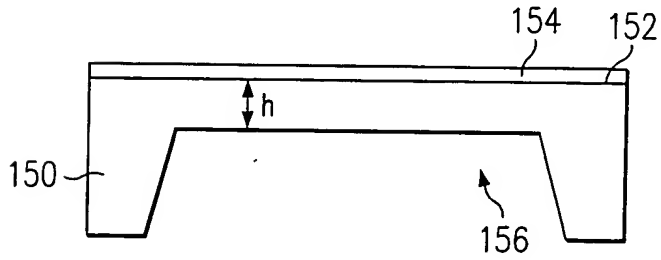

FIG. 4

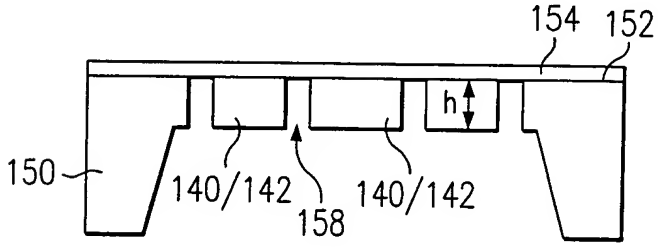

FIG. 5

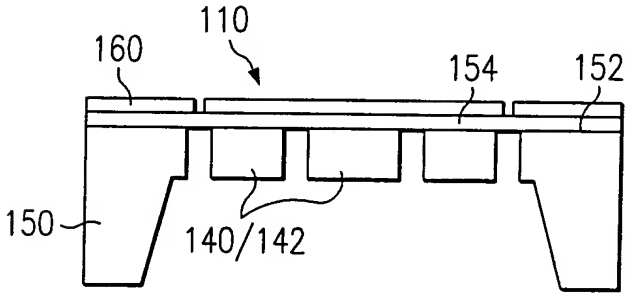

FIG. 6

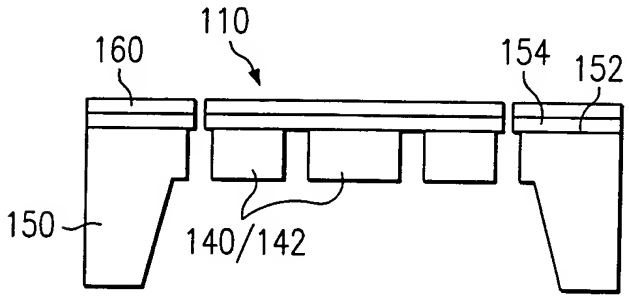

FIG. 7

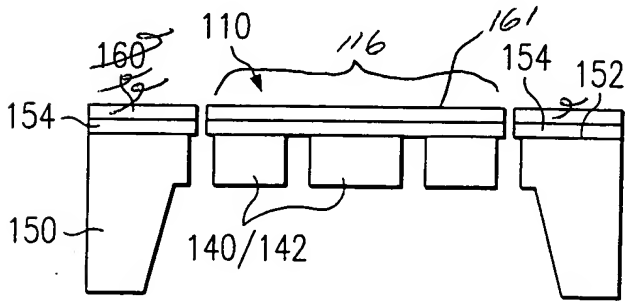

FIG. 8